इंटरनेट मानक

Disclosure to Promote the Right To Information

Whereas the Parliament of India has set out to provide a practical regime of right to information for citizens to secure access to information under the control of public authorities, in order to promote transparency and accountability in the working of every public authority, and whereas the attached publication of the Bureau of Indian Standards is of particular interest to the public, particularly disadvantaged communities and those engaged in the pursuit of education and knowledge, the attached public safety standard is made available to promote the timely dissemination of this information in an accurate manner to the public.

"जानने का अधिकार, जीने का अधिकार"
Mazdoor Kisan Shakti Sangathan
"The Right to Information, The Right to Live"

"पुराने को छोड नये के तरफ"
Jawaharlal Nehru
"Step Out From the Old to the New"

IS 13225 (1992): Automotive Vehicles - Hydraulic Braking Systems - Rubber Cups [TED 4: Automotive Braking Systems]

"ज्ञान से एक नये भारत का निर्माण"
Satyanarayan Gangaram Pitroda
"Invent a New India Using Knowledge"

Act Number 22 of 2005
The Indian Parliament
RIGHT TO INFORMATION

Made Available By
Public.Resource.Org

"ज्ञान एक ऐसा खजाना है जो कभी चुराया नहीं जा सकता है"
Bhartṛhari—Nītiśatakam
"Knowledge is such a treasure which cannot be stolen"

BLANK PAGE

BRUTUM FULMEN

IGNORANTIA JURIS NON EXCUSAT

PROTECTED BY COPYRIGHT

भारतीय मानक

स्वचालित वाहन – द्रवचालित ब्रेकिंग तंत्र – रबड़ कप – विशिष्टि

Indian Standard

AUTOMOTIVE VEHICLES — HYDRAULIC BRAKING SYSTEMS — RUBBER CUPS — SPECIFICATION

UDC 629·113-592·2

© BIS 1992

BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

January 1992 **Price Group 7**

Automotive Braking Systems Sectional Committee, TED 4

FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by Automotive Braking Systems Sectional Committee had been approved by the Transport Engineering Division Council.

Braking system components play a vital role in the overall safety of a vehicle. This Indian Standard specifies the requirements for rubber cups used in a hydraulic braking system. This standard is one in the series of Indian Standards being developed for braking systems of road vehicles.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

AMENDMENT NO. 3 MAY 2007
TO
IS 13225 : 1992 AUTOMOTIVE VEHICLES — HYDRAULIC BRAKING SYSTEMS — RUBBER CUPS — SPECIFICATION

[*Page* 1, *clause* 7(3)] — Delete the marking 'Origin to establish the source of manufacture'.

(*Page* 1, *clause* 8) — Add the following at the end:

'Each packing slip shall also be marked with Date of packing and Kit Part No.'

[*Page* 2, *Table* 1, *Sl No.* (h), Ozone Resistance] — Delete.

(*Page* 13, *Annex* H) — Delete the text alongwith Figures 8 and 9.

(TED 4)

Reprography Unit, BIS, New Delhi, India

AMENDMENT NO. 2 JUNE 2006
TO
IS 13225 : 1992 AUTOMOTIVE VEHICLES — HYDRAULIC BRAKING SYSTEMS — RUBBER CUPS — SPECIFICATION

(*Page* 1, *clause* 2) — Substitute the following for the existing and replace the referred IS No. wherever appearing in the text with the following:

2 REFERENCE

The following standards contain provisions, which through reference in this text, constitute provisions of this standard. At the time of publication the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below:

IS No.	*Title*
410 : 1977	Cold rolled brass sheet, strip and foil (*third revision*)
737 : 1986	Wrought aluminium and aluminium alloy sheet and strip for general engineering purposes (*third revision*)
1070 : 1992	Reagent grade water — Specification (*third revision*)
1448 (Part 41) : 1992	Methods of test for petroleum and its products : Part 41 Water and sediment in crude oils and fuel oils by centrifuge (*second revision*)
1570 (Part 2/ Sec 2) : 1987	Schedules for wrought steels : Part 2 Carbon steels (unalloyed steels), Section 2 Carbon steel wires with related properties (*first revision*)
2631 : 1976	Specification for ISO propyl alcohol (*first revision*)
3355 : 1974	Grey iron castings for elevated temperatures for non-pressure containing parts (*first revision*)
3400 (Part 2) : 2003 hardness	Methods of test for vulcanized rubber : Part 2 Rubber, vulcanized or thermoplastic — Determination of (hardness between 10 IRHD and 100 IRHD) (*third revision*)

IS No.	*Title*
8654 : 2001	Automotive hydraulic brake fluid, heavy duty — Specification (*second revision*)
14811 : 2000	Rolled copper plate, sheet, strip and foils for general engineering purposes — Specification

(*Page* 1, *clause* 7) — Substitute the following for the existing:

'7 MARKING

7.1 Each rubber boot shall be marked with the following:

a) Manufacturer's name, his initials or trade-mark;
b) Type; and
c) Identification of mould (Cavity No).

7.1.1 Date of packing or Control Unit No. on packages.

7.2 BIS Standard Mark

Rubber cups may also be marked with the Standard Mark.

7.2.1 The use of the Standard Mark is governed by the provisions of the *Bureau of Indian Standards Act*, 1986 and the Rules and Regulations made thereunder. The details of conditions under which the licence for the use of Standard Mark may be granted to the manufacturers or producers may be obtained from the Bureau of Indian Standards.'

[*Page* 6, *clause* **E-3.1**(f)] — Substitute 'IS 14811' *for* 'IS 1972 : 1977'.

(TED 4)

Reprography Unit, BIS, New Delhi, India

AMENDMENT NO. 1 MAY 1995
TO
IS 13225 : 1992 AUTOMOTIVE VEHICLES — HYDRAULIC BRAKING SYSTEMS — RUBBER CUPS — SPECIFICATION

[*Page* 2, *Table* 1, *Sl No.* (g), *matter under the title 'Lip Diameter Change'*] — **Substitute the following for the existing matter:**

i) *Lip Diameter Change*

The minimum lip diameter of master and wheel cylinder cups after the stroking test shall be greater than the master and wheel cylinder bores by the dimensions as tabulated below:

Diameter of cups mm	*Excess Over Bore Dia, mm*	
	Master Cylinder	Wheel Cylinder
Up to 25.4	0.381	0.508
Over 25.4 up to 38.1	0.508	0.635
Over 38.1 up to 50.8	0.635	0.762

(TED 4)

Reprography Unit, BIS, New Delhi, Indi

parts (*first revision*) manufacture and t

Indian Standard

AUTOMOTIVE VEHICLES — HYDRAULIC BRAKING SYSTEMS — RUBBER CUPS — SPECIFICATION

1 SCOPE

1.1 This standard specifies the general and performance requirements of moulded cups upto 51 mm diameter used in master and wheel cylinders used in hydraulically operated braking systems of automotives.

1.2 This standard does not cover seals used for disc brakes. The material requirements of rubber components is excluded from the scope of this Indian Standard.

2 REFERENCES

The following Indian Standards are necessary adjuncts to this standard:

IS No.	*Title*
410 : 1981	Cold rolled brass sheet, strip and foil (*third revision*)
737 : 1986	Wrought aluminium and aluminium alloy sheet and strip for general engineering purpose (*third revision*)
1070 : 1977	Water for general laboratory use (*second revision*)
1448 (Part 41) : 1984	Method of test for petroleum and its products : Part 41 Water and sediment in crude oils and fuels oils by centrifuge (*second revision*)
1570 (Part 2/ Sec 2) : 1987	Schedules for wrought steels : Part 2 Carbon steels (unalloyed steels), Section 2 Carbon steel wires with related properties (*first revision*)
1972 : 1977	Copper plate, sheet and strip for industrial purposes (*first revision*)
2631 : 1976	Isopropyl alcohol (*first revision*)
3355 : 1974	Grey iron castings for elevated temperature for non pressure containing parts (*first revision*)
3400 (Part 2) : 1980	Method of test for vulcanised rubbers : Part 2 Hardness (*first revision*)
8654 : 1986	Automotive hydraulic brake fluid, heavy duty (*first revision*)

3 TYPES

3.1 The rubber cups are of following types:

Class 1 For normal temperature applications

Class 2 For high temperature applications

4 MATERIAL

4.1 For class 1 category natural rubber is recommended. For Class 2 SBR/EPDM rubber is recommended.

5 GENERAL REQUIREMENTS

5.1 Cups shall be free from blisters, pin holes cracks, protuberances, embedded foreign material, or other physical defects which can be detected by thorough inspection and shall conform to the dimensions specified by the manufacturer.

5.2 The brake fluid used in the system shall conform to IS 8654 : 1986.

6 PERFORMANCE REQUIREMENTS

6.1 The rubber cups performance when tested in accordance with the procedures, given in Annexes A to H shall comply with the requirements given in Table 1.

7 MARKING

Each cup shall be marked with the following:

1) Type;
2) Manufacturer's name, initial or trade mark; and
3) Origin to establish the source of manufacture.

8 PACKING

The rubber cups shall be supplied suitably protected for environmental degradation. Each packing shall indicate, the type, size, source of manufacture and trade mark etc.

Table 1 Performance Requirements
(*Clause* 6.1)

Sl No.	Description	Performance Requirements	Test Methods (Reference)
a)	Resistance to Fluid at Elevated Temperatures	When tested as per A-4, the cups shall conform to the requirements given below: *Class 1* *Class 2* Change in volume 0 to 15% + 5 to 20% Change in outside dia 0 to +5% 0 to 6% Change in outside dia base 0 to 5% 0 to 6% Hardness deg IRH −10 to 0 − 15 to 0 The cups shall show no excessive disintegration as revealed by blisters or sloughing.	Annex A
b)	Precipitation	When tested as per B-4 not more than 0·3 percent sediments by volume shall be formed in the centrifuge tube after the cups have been tested as per specification.	Annex B
c)	Oven Ageing	When tested as per C-3, the cups shall meet the following requirements; The change in rubber hardness shall be within the limits of −5 to +5 deg IRH, and the cups shall show no evidence of deterioration or change from original apparances.	Annex C
d)	Low Temperature Performance	When tested as per D-1.3.1, no leakage of fluid shall occur. When tested as per D-2.2, the cylinder cup shall not crack and shall return to its approximate original shape within 1 min.	Annex D
e)	Corrosion resistance	When tested as per Annex E the cups shall not cause corrosion exceeding the limits as shown below: i) Mass change mg/cm^2 *Max* Tinned iron 0·2 Steel 0·2 Aluminium 0·1 Cast iron 0·2 Brass 0·4 Copper 0·4 ii) Condition of the test metal strips — No visible pitting or etching iii) Appearance of test fluid in the jar at 23 ± 5 deg C — No jelling iv) Crystalline deposit on the walls of the test jar, test metal strips — None v) Sediments, percent by volume, *Max* — 0·2	Annex E
f)	Storage corrosion	When tested as per F-2, the cups shall meet the following requirements: After 12 cycles in the humidity cabinet. there shall be no evidence of corrosion adhering to or penetrating the wall of the cylinder bore which was in contact with the test cups. Slight discolouration (staining) or any corrosion or spots away from the contact surface of the test cups shall not be cause for rejection.	Annex F
g)	Heat Pressure Stroking (master & wheel cylinder)	The master cylinder and wheel cylinder cups when tested as per Annex G shall meet the following requirements: i) *Lip Diameter Change* The minimum lip diameter of wheel cylinder cups after the stroking test shall be greater than the wheel cylinder bore by the minimum dimensions as tabulated below. *Wheel cylinder cups* Diameter in mm — *'Excess over Bore'* mm Upto 25·4 — 0·508 Over 25·4 upto 38·1 — 0·635 Over 38·1 upto 50·8 — 0·762 ii) *Leakage* Constant dampness past the cups or fluid discoloration of the filter paper on two or more inspection shall be cause for rejection. iii) *Change in hardness* Rubber cups shall not decrease in hardnees by more than 15 deg IRH, or the primary and secondary master cylinder test cups shall not decrease in hardness by more than 15 deg IRH. iv) *Condition of test cups* The primary and secondary cups shall not show excessive determination such as scoring, scuffing, blistering, cracking, chipping (heel abrasion). or change in shape from original appearance.	Annex G
h)	Ozone Resistance (master and wheel cylinder rubber cup)	When tested as per Annex H the surface of the specimen cups shall show no evidence of cracking, rupture or other deterioration at the end of 70 hours exposure period, when examined under 2X magnification.	Annex H

ANNEX A

[*Clause* 6.1 (a)]

RESISTANCE TO FLUID AT ELEVATED TEMPERATURES

A-1 TEST SPECIMEN

Two cups minimum shall be used for testing.

A-2 TEST APPARATUS

Micrometer, shadowgraph or other suitable apparatus to measure accurately to 0·02 mm and glass containers of approximately 250 cm^3 capacity which can be tightly sealed.

A-3 TEST CONDITIONS

Shall be as given in Table 2.

Table 2 Resistance to Fluid at Elevated Temperature Test Conditions

(*Clause* A-3 *and* A-4.5)

Classification	Test Temperature	Test Time
Class 1	70 ± 1°C	120 ± 2 hours
Class 2	120 ± 2°C	70 ± 1 hour

A-4 TEST PROCEDURE

A-4.1 The cups shall be rinsed in isopropyl or ethyl alcohol and wiped dry with a clean, lint-free cloth to remove dirt and packing debris. Cups shall not be left in the alcohol for more than 30 seconds.

A-4.2 The lip and base diameters shall be measured to the nearest 0·02 mm taking the average of two readings at right angles to each other. Care shall be taken while measuring the diameters before and after ageing that the measurements be taken in the same manner and at the same locations.

A-4.3 Determine and record the initial hardness of the test cup as per IS 3400 (Part 2) : 1980.

A-4.4 The volume of each cup shall be determined in the following manner using an analytical balance:

> Weigh the cups in air (W_1) to the nearest milligram and then weigh the cup immersed in distilled water at room temperature (W_2). Quickly dip each specimen in alcohol and then blot dry with filter paper free of lint and foreign material.

A-4.5 The test cups shall be completely immersed in 75 cm^3 of test fluid (Automotive hydraulic brake fluid conforming to IS 8654 : 1986) in a suitable glass container and the container shall be sealed to prevent vapour loss. The container shall be placed in an oven to the temperature and period as mentioned in Table 2 test conditions.

A-4.6 At the end of heating period, remove the cups from the oven and allow to cool in the container at 23 ± 5°C for 60 - 80 minutes. After cooling, remove the cups from the container and rinse in isopropyl or ethyl alcohol and wipe dry with a clean, lint-free cloth. Cups shall not remain in the alcohol for more than 30 seconds.

A-4.7 After removal from the alcohol and drying, weigh the cups in air (W_3).

A-4.8 Afterwards weigh the cup immersed in distilled water at room temperature (W_4).

A-4.9 Calculation and Report

A-4.9.1 *Volume Change*

Shall be reported as a percentage of the original volume. The calculation shall be made as follow:

percentage increase in volume

$$= \frac{(W_3 - W_4) - (W_1 - W_2)}{(W_1 - W_2)} \times 100$$

where

W_1 = Initial mass in air,

W_2 = Initial mass in water,

W_3 = Mass in air after immersion in test fluid (after test), and

W_4 = Mass in water after test.

A-4.9.2 *Dimensional Change*

The original measurements shall be subtracted from the measurements taken after the test and the difference reported as a percentage of the original diameters.

A-4.9.3 Change in hardness shall be determined and recorded.

A-4.9.4 Examine the cups for disintegration as evidenced by blisters or sloughing.

ANNEX B
[*Clause* 6.1 (b)]

PRECIPITATION TEST

B-1 TEST SPECIMEN

Two cups shall be used for testing.

B-2 TEST APPARATUS

Shall be glass containers having a capacity of approximately 250 cm^3 which can be tightly sealed and cone shaped centrifuge tube of 100 cm^3 capacity.

B-3 TEST CONDITIONS

Shall be as given in Table 3.

Table 3 Precipitation Test Conditions
(*Clause* B-3 *and* B-4.1)

Classification	Test Temperature	Test Time
Class 1	70 ± 1°C	120 ± 2 hours
Class 2	120 ± 2°C	70 ± 1 hour

B-4 TEST PROCEDURE

B-4.1 Place the cups in a suitable glass container containing 75 cm^3 of the test fluid (Automotive hydraulic brake fluid conforming to IS 8654 : 1986). The container shall be sealed to prevent vapour loss and placed in an oven to the temperature and period as mentioned in Table 3 test conditions.

B-4.2 At the end of heating period, remove the container from the oven and allow to cool at room temperature for 24 hours after which, the cups are removed.

B-4.3 The contents of the jar shall be thoroughly agitated and transferred to a cone shaped centrifuge of 100 cm^3 capacity and the sediment determined as per the method given in IS 1448 (Part 41) : 1984.

ANNEX C
[*Clause* 6.1 (c)]

OVEN AGEING

C-1 TEST SPECIMEN

Two cups shall be used for testing.

C-2 TEST CONDITIONS

Shall be as given in Table 4.

Table 4 Oven Ageing Test Conditions
(*Clause* C-2 *and* C-3.3)

Classification	Test Temperature	Test Time
Class 1	70 ± 1°C	120 ± 2 hours
Class 2	120 ± 2°C	70 ± 1 hour

C-3 TEST PROCEDURE

C-3.1 Two cups shall be rinsed in isopropyl alcohol and wiped dry in a clean, lint-free cloth. Cups shall not remain in alcohol for more than 30 seconds.

C-3.2 The hardness of the cups shall be determined and recorded.

C-3.3 Place the cups in the hot air oven to the temperature and period as mentioned in Table 4.

C-3.4 At the termination of test period, the cups shall be removed from the oven and allowed to cool for 16-26 hours at room temperature.

C-3.5 The rubber hardness after ageing shall be determined and recorded.

C-3.6 The cups shall be inspected for blistering, or change in shape from original appearance.

ANNEX D
[*Clause* 6.1 (d)]

LOW TEMPERATURE PERFORMANCE

D-1 LEAKAGE TEST

D-1.1 Test Specimen

One master cylinder assembly and one wheel cylinder assembly.

D-1.2 Test Apparatus

The leakage test apparatus as shown in Fig. 1. A cold chamber large enough to permit arrangement of the test apparatus within the chamber.

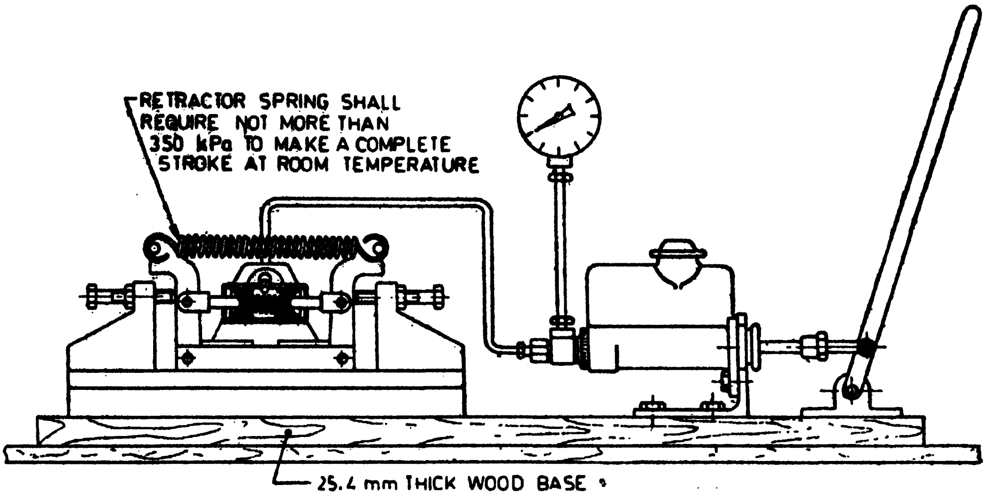

RETRACTOR SPRING SHALL REQUIRE NOT MORE THAN 350 kPa TO MAKE A COMPLETE STROKE AT ROOM TEMPERATURE
25.4 mm THICK WOOD BASE

FIG. 1 LOW TEMPERATURE LEAKAGE TEST APPARATUS

A master cylinder and wheel cylinder so connected that their operation closely approximates the brake system in actual service. The cylinder bore containing the test cups shall meet the dimensional limitations and bore finish requirements specified by the manufacturer.

D-1.3 Procedure

D-1.3.1 The wheel cylinder and master cylinder assemblies containing the test cups shall be installed in the test apparatus in the cold chamber. The system shall be filled with heavy duty Automotive hydraulic brake fluid conforming to IS 8654 : 1986 and all air bled from the system. Boots shall not be used.

D-1.3.2 The complete actuating system shall be enclosed in the cold chamber and subject to a temperature of −40 to −43°C. The piston and cups shall remain in a static position during the first 72 hours of the test and thereafter, shall be actuated 6 strokes at 0·7 MPa and 6 strokes at 3·5 MPa after each 24 hours, that is, after 72, 96 and 120 hours. The strokes shall be approximately 1 min apart and the piston shall return to the stop after each stroke. No leakage shall occur during the 120 hours test period.

D-2 BEND TEST

D-2.1 Test Specimen

One cup shall be used.

D-2.2 Procedure

The test cup after being subjected to 22 hours at −40 to −43°C shall be bent through an angle of approximately 90 deg and immediately released. Within one minute, examine the test cup for cracking and change in shape from original appearance.

ANNEX E

[*Clause* 6.1 (e)]

CORROSION RESISTANCE TEST

E-1 OUTLINE OF THE METHOD

Six specified metal corrosion test strips are polished, cleaned and weighed, are assembled as described. Assembly is placed on a standard wheel cylinder cup in corrosion test jar immersed in the water-wet brake fluid, capped and placed in an oven at 100°C for 120 hours. Upon removal and cooling the strips, fluid and cups are examined and tested.

E-2 EQUIPMENT

E-2.1 Balance

An analytical balance having a minimum capacity of 50 g and capable of weighing to the nearest 0·1 mg.

E-2.2 Desiccators

Desiccators containing silica gel or other suitable desiccant.

E-2.3 Oven

Gravity connection oven capable of maintaining the desired set point within 2°C.

E-2.4 Micrometer

A machinist's micrometer 25 to 50 mm capacity, or an optical comparator, capable of measuring the diameter of the SBR wheel cylinder cups to the nearest 0·02 mm.

E-3 MATERIALS

E-3.1 Corrosion Test Strips

Test strips shall be 80 mm long, 13 mm wide, and not more than 6 mm thick with a hole of 4 to 5 mm diameter drilled at about 6 mm from one end of the strip. The metal strips shall be of tinned iron steel, aluminium, cast iron, brass and copper conforming to the following description and specifications:

a) *Tinned Iron*

The strip shall be free from laminations, blisters, silver, rolled-in-scale, pits, ragged edges, holes turn down corners, black or white edges, scruffy metal, uncoated spots or other defects. The mass of tin coating, both sides taken together shall not be less than 27 g/m².

b) *Steel*

The strips shall be made from alloy steel sheet (cold rolled), which shall be free from seams, laminations, blisters, excessive detachable scales and other defects. The steel shall conforming to designation C 10 of IS 1570 (Part 2/Sec 2): 1987 and with the phosphorus (as P) and sulpur (as S) limited to 0·040 percent and 0·050 percent maximum, respectively.

c) *Aluminium Alloy*

The strip shall be made from annealed aluminium alloy sheet which shall be uniform in quality and condition, sound, smooth, flat free from buckles and other defects. The alloy shall conform to grade H14 of IS 737 : 1986.

d) *Cast Iron*

The strip shall be made from grey cast iron conforming to grade I of IS 3355 : 1974 or from a brake cylinder of known make.

e) *Brass*

The strip shall be made from brass sheet conforming to grade Cu, Zn 30 of IS 410 : 1981. The sheet shall be clean smooth flat and free from temper. The sheet shall also be free from foreign material, pipes, laps slives cracks, scales, buckles and other defects.

f) *Copper*

The strip shall be made from the light, cold rolled copper sheet, the copper content of which shall not be less than 99·9 percent (*see* IS 1972 : 1977); silver, if any, being taken as copper.

E-3.2 SBR Cups

Two unused standard 32 mm diameter wheel cylinder (WC) cups.

E-3.3 Corrosion Test Jars and Lids

Two screw topped straight sided round glass jars, each having a capacity of approximately 475 ml and inner dimensions of approximately 100 mm in height and 75 mm in diameter and a tinned steely lid (no insert or organic coating) vented with a hole 0·3 ± 0·1 mm in diameter.

E-3.4 Machine Screws and Nuts

Clean, rust and oil-free uncoated mild steel round or fillister head machine screw of approximately 18 mm length and machine uncoated nuts.

E-3.5 Supplies for Polishing Strips

Waterproof silicon carbide paper, grit No. 320, grade 00 steel wool, lintfree polishing cloth.

E-3.6 Distilled Water — *see* IS 1070 : 1977.

E-3.7 Isopropanol — *see* IS 2631 : 1976.

E-4 PROCEDURE

E-4.1 Except for the tinned iron strips, abrase corrosion test strips on all surface areas with silicon carbide paper wet with isopropanol until all surface scratches, cutes and pits are removed. Use a new piece of paper for each different type of metal. Polish the strips with the 00 grade steel wool. Wash all strips, including the tinned iron and the assembly hardware, with isopropanol ; dry the strips and assembly hardware with a clean lint-free cloth or use filtered compressed air and place the strips and hardware in a desciccator containing silica gel or other suitable desicant and maintained at 23 ± 5°C for at least one hour. Handle the strips with forceps after polishing. Weight and record the mass of each strip to the nearest 0·1 mg. Assemble the strips on a clean dry machine screw, with matching plain nut, in the order of tinned iron, steel, aluminium, cast iron brass and copper. Bend the strips, other than the cast iron, so that there is a separation of 3 ± 0·5 mm between adjacent strips for a distance of about 50 mm from the free end of the strips (*see* Fig. 2). Tighten the screw on each test strips assembly so that outer strips (tinned iron or copper) without any of the strips moving, relative to the others when held horizontally. Immerse the strip assemblies in isopropanol. Dry with dried filtered compressed air, then desiccate at least one hour before use.

E-4.2 Measure the base diameters of the two standard SBR cups using an optical comparator or micro meter to the nearest 0·02 mm along the centreline of the SAE and rubber-type identifications and at right angle to this centerline. Take the measurement at least 0·4 mm above the bottom edge and parallel to the base of the cup. Discard any cup if the two measured diameter differ by more than 0·08 mm.

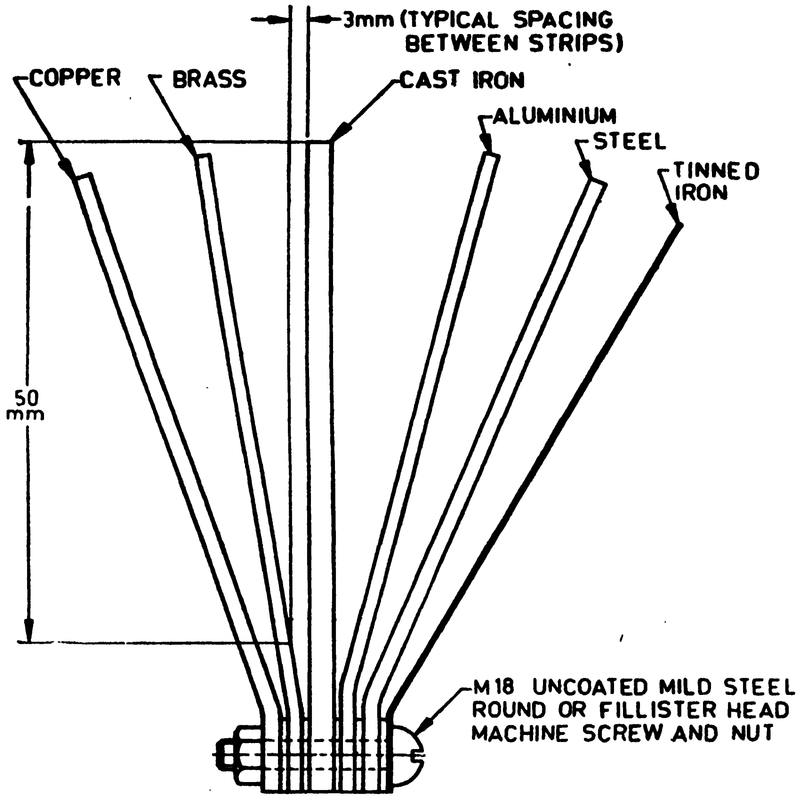

3mm (TYPICAL SPACING BETWEEN STRIPS)
COPPER
BRASS
CAST IRON
ALUMINIUM
STEEL
TINNED IRON
50 mm
M18 UNCOATED MILD STEEL ROUND OR FILLISTER HEAD MACHINE SCREW AND NUT

FIG. 2 CORROSION STRIP ASSEMBLY

Average the two readings on each cup. Determined the hardness of the cups by the method given in IS 3400 (Part 2) : 1980.

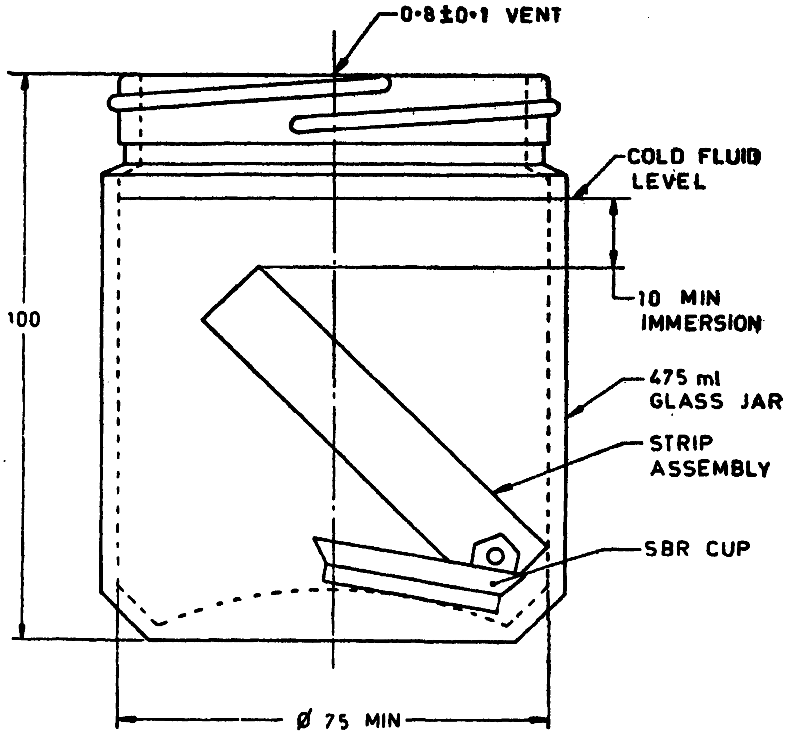
E-4.3 Rinse the cups in isopropanol for not more than 30 seconds and wipe dry with a clean lint-free cloth. Place one cup with lip edge facing up in each jar. Insert a metal strip assembly inside each cup with the fastened end down and the free and extending upward (*see* Fig. 3). Mix 760 ml of brake fluid with 40 ml of distilled water. Using this water wet mixture, cover each strip assembly to a minimum depth of 10 mm above the tops of the strips. Tighten the lids and place the jars for 120 ± 2 h in an oven maintained at 100 ± 2°C. Allow the jars to cool at 23 ± 5°C for 60 to 90 minutes. Immediately remove the strips from the jars using forceps, agitating the strip assembly in the fluid to remove adhering sediment. Examine the test strips jars for adhering crystaline deposits. Disassemble the metal strips and remove adhering fluid by flushing with water; clean each strips by wiping with a clean cloth wetted with isopropanol. Examine the strips for evidence of corrosion and pitting.

Disregard staining or discolouration. Place the strips in a desiccator maintained at 23± 5°C for at least 1h. Weigh each strip to the nearest 0·1 mg. Determine the change in mass of each metal strip. Average the results for the two strips of each type of metal. Immediately following the cooling period remove the cups from the jars with forceps. Remove loose adhering sediment by agitation of the cups in the mixture. Rinse the cups in isopropanol and air-dry. Examine the cups for evidence of sloughing, blisters and other forms of disintegration. Measure the base diameter and hardness of each cup within 15 minutes after removal from the mixture. Examine the mixture for gelling. Agitate the mixture to suspend, uniformly disperse, and then sediment. From each jar, transfer a 100 ml portion of the mixture to a cone-shaped centrifuge tube and determine the percent sediment by the method given in IS : 1448 (Part 41)-1984. Further measure the *p*H value of the test mixture.

E-5 CALCULATION AND REPORTING

E-5.1 Measure the area of each type of test strip to the nearest square centimetre. Divide the average change in mass for each type by the area of that type.

E-5.2 Note other data and evaluations indicating compliance. In the event of a marginal pass on inspection by attributes, or of a failure in one of the duplicate, run another set of duplicate samples. Both repeat samples shall meet all requirements.



All dimensions in millimetres.

FIG. 3 CORROSION TEST APPARATUS

ANNEX F

[*Clause* 6.1 (f)]

STORAGE CORROSION

F-1 APPRATUS

The apparatus shall include a humidity cabinet capable of maintaining a temperature of 21°C to 46°C at 95 percent relative humidity. Three wheel cylinder assemblies of proper size for the cups being tested.

F-2 PROCEDURE

Disassemble the three cylinder assemblies and using a clean, lintfree cloth, wipe all fluids from the cylinders, pistons, boots and springs. Cylinder or parts showing light stains or corrosion shall be discarded.

F-2.1 Assemble the six test cups into the wheel cylinders after completely coating the cylinder walls, cups, springs and pistons with a light film of the test fluid. Install of the clean boots in the cylinders to hold the pistons in position. Leave one inlet hole open and close the remaining holes with suitable rubber or metal plugs.

F-2.2 Number the cylinders and adjust the humidity cabinet to 46 ± 2°C and 95 percent relative humidity. Place the cylinders in the cabinet with the unplugged inlet holes facing down, maintain the specified temperature and humidity conditions for 16 h. Readjust the cabinet controls to 23 ± 2°C and 95 percent relative humidity and maintain new conditions for 8 h to complete the first cycle. Repeat the above 24 h cycle for 12 days. When interrupted due to incidence of one or more non-working days the cylinder assemblies shall remain in the humidity cabinet with the cabinet controls set to maintain 23 ± 2°C at 95 percent relative humidity until cycling can be resumed. At the conclusion of 12 complete cycles the cylinder assemblies shall be removed from the humidity cabinet for inspection.

F-2.3 Cylinder assemblies shall be inspected as follows :

During the removal from the humidity cabinet and subsequent disassembly the cylinders shall be maintained in the same position as they were in the cabinet to avoid fluid contamination of the inside of the cylinder. The pistons and cups shall be removed from the cylinders, after removal of the boots, by pulling them out from their respective ends; slight air (dry) pressure may be applied internally in the cylinder, if necessary to aid in the removal of cups and pistons. Wipe the cylinder bore of fluid with a clean, lint-free cloth.

F-2.4 Results of Observation

The conditions of the cylinder bore under or adjacent to the cup lip shall be inspected under a strong light for corrosion, discolouration, or spots, noting particularly the area of the ring left by the lip of the cup during its exposure in the humidity cabinet. Any corrosion or spots away from the contact surface of the cups shall be disregarded.

ANNEX G

[*Clause* 6.1 (g)]

WHEELS AND MASTER CYLINDER HEAT PRESSURE STROKING

G-1 TEST SPECIMEN

For master cylinder two cups (one primary and one secondary) and for wheel cylinder two cups shall be used.

G-2 TEST APPARATUS

G-2.1 A well designed, uniformly heated, standard dry air oven.

G-2.2 Actuating Heat Pressure Stroking Fixtures for Master cylinder cups

G-2.2.1 The stroking machine shall consist of a suitable means for actuating the master cylinder containing the test specimens at the rate of 1 000 ± 100 strokes per hour. The total piston movement shall be sufficient to cover approximately 90 percent of the total available stroke. The rate of stroke shall be 1 000 ± 100 strokes per hour. Full pressure of 7 MPa shall be attained and maintained.

Fig. 4 Illustrates typical pressure in MPa versus the master cylinder movement obtained with three wheel cylinders of approximately 22 mm diameter mounted in the three stroking fixtures as shown in Fig. 5.

The initial movement of approximately 14-15 mm shall be at a rate providing a gradual build up of pressure not to exceed 1 MPa. This shall permit the primary cup to pass over the compensating port at a low pressure. The balance of the stroke shall provide a gradual build up of pressure to 7·0 ± 0·3 MPa during the last 1·6 to 3·2 mm of stroke. This remaining stroke at 7·0 ± 0·3 MPa shall be held constant by an adjustable relief valve.

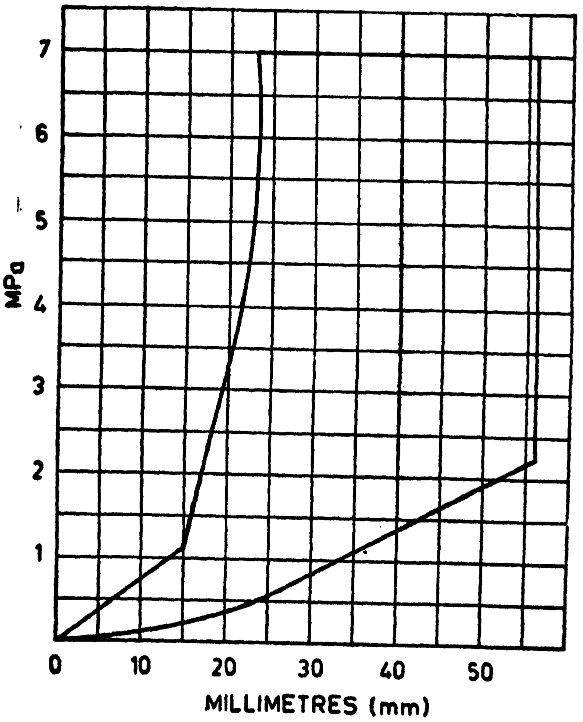


FIG. 4 TYPICAL STROKING TEST FOR MASTER CYLINDER CUP (25 MM)

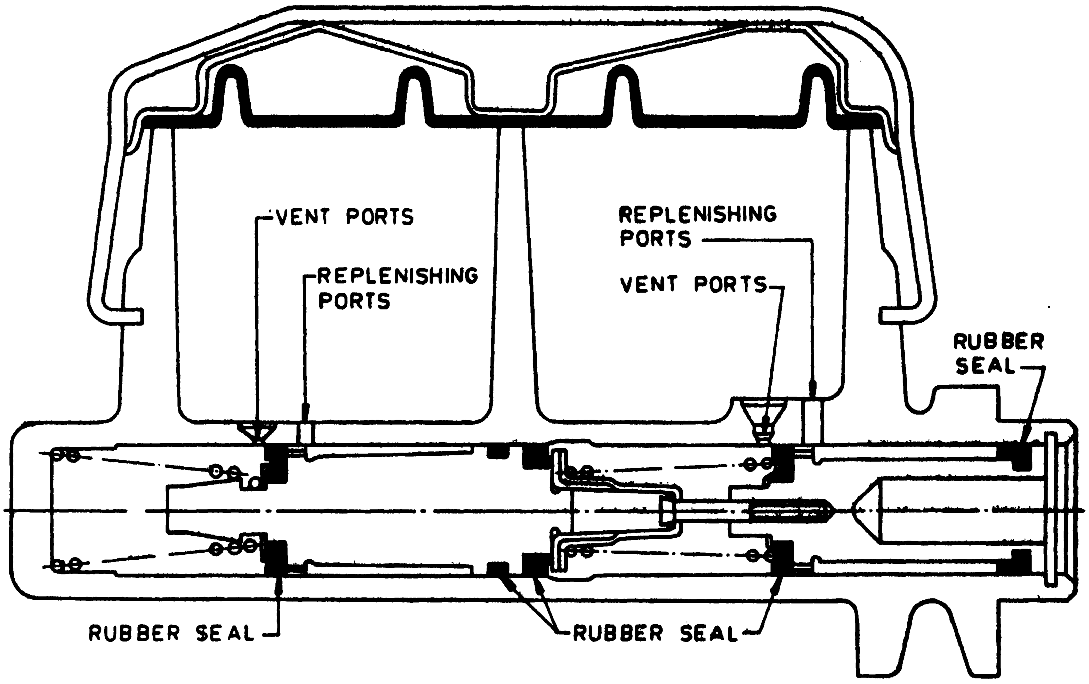


FIG. 5 MASTER CYLINDER NOMECLATURE

The master cylinder shall be located in uniformly heated, dry air oven and the fluid temperature in the master cylinder reservoir shall be maintained at 120/70 °C as applicable.

NOTE — A master cylinder cup must be used for each test. It is recommended that at least 0·05/0·13 mm clearance be allowed between the master cylinder piston and the master cylinder bore when conducting a master cylinder stroking test.

G-2.3 Actuating Heat Pressure Stroking Fixture for Wheel Cylinder Cups

G-2.3.1 The actuating heat pressure stroking fixtures shall be designed to provide 3·8 ± 1·7 mm movement of each piston. During total movement of the piston, the pressure shall increase to 7·0 ± 0·3 MPa The rate of operation shall be held at a uniform reciprocating motion of 1 000 ± 100 strokes/hour.

Figure 6 Illustrates a recommended pressure in MPa versus wheel cylinder piston for wheel cylinders with 12·7 to 50·8 mm diameter.

Figure 7 illustrates a general setup showing master cylinder and wheel cylinder stroking arrangement inside the oven.

NOTE — A new wheel cylinder assembly must be used for each test.

G-3 TEST CONDITIONS

The temperature and test period for class 1 and class 2 type cylinder cups are tabulated below.

Classification	*Test Temperature*	*Test time*	*Test Pressure*
Class 1	70 ± 1°C	120 ± 2 h	7·0+0·3 MPa
Class 2	120 ± 2°C	70 ± 1 h	7·0+0·3 MPa

G-4 TEST PROCEDURE

G-4.1 The master cups shall be rinsed in Isopropyl or ethyl alcohol and wiped dry with a clean, lint-free cloth to remove dirt and packing debris. Cups shall not remain in the alcohol for more than 30 seconds.

Determine and record the initial hardness of the test cups the lip dia of the primary and secondary cups shall be measured and recorded to the nearest 0·02 mm, taking the average of two readings at right angles to each other. The lip diameter of the secondary cup shall be measured after the cup has been assembled on the piston.

The cups and master cylinder internal parts shall be dipped in the test fluid and the cylinder walls coated with the specified test fluid before assembly.

The master cylinder assembly after installation in an oven shall be operated for 120/70 hours applicable at the rate of 1 000 ± 100 strokes per hour at a temperature of 70/120 °C as applicable. After approximately one hour of stroking to allow for evaporation of excess lubricant used for assembly, place a sheet of filter paper under the secondary cup of the master cylinder to catch and determine leakage past the secondary cup. The heat and actuating means shall be shut off at the termination of 70/120 hours of stroking period as tabulated above with the master cylinder in the 'off' position to relieve retained pressure in the master cylinder. After one hour cooling period with the oven door open and the ventilating fan 'on', disconnect the fluid line at the master cylinder outlet. Remove the master cylinder from the oven and allow to cool for 22 ± 2 hours at room temperature. Immediately after completing 22 h

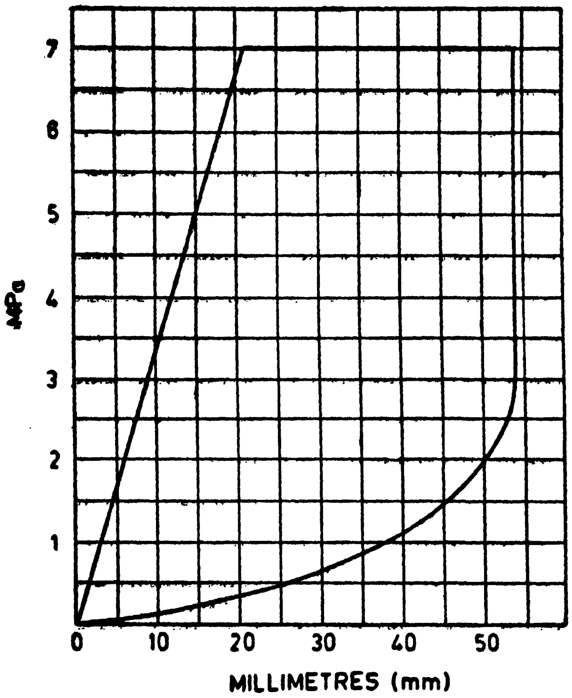


FIG. 6 TYPICAL WHEEL CYLINDER CUP MOVEMENT VERSUS PRESSURE

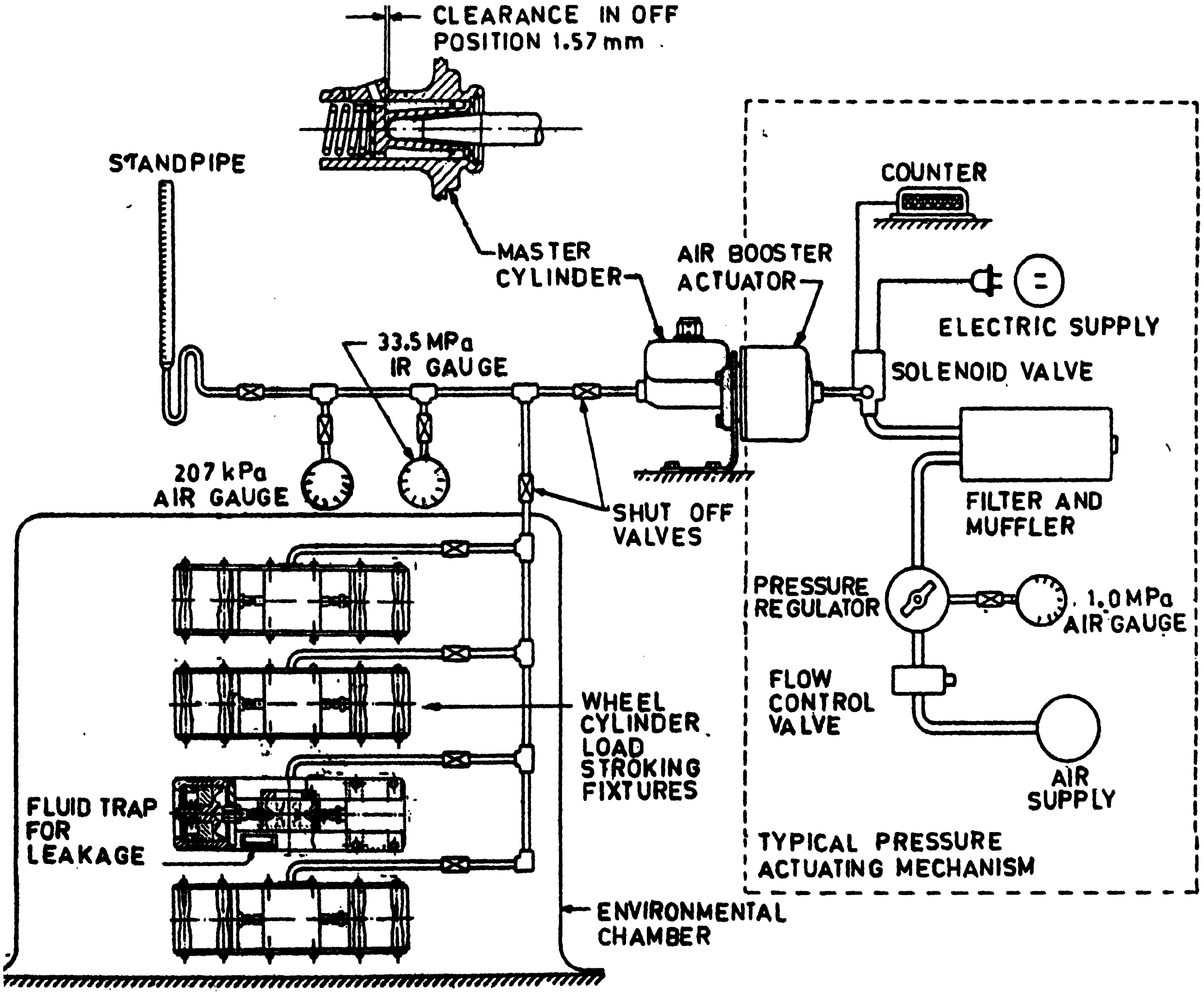


FIG. 7 TEST APPARATUS

hours cooling period, careful inspection shall be made to check for fluid leakage past the master cylinder secondary cup. The fluid shall be drained from the master cylinder. The primary cup shall be removed from the master cylinder, rinsed with Isopropyl or Ethyl alcohol, and dried with compressed air. The secondary cup on the piston shall be rinsed in Isopropyl or Ethyl alcohol, dried with compressed air and the lip diameter measured before removal from the piston. Cups shall not remain in the alcohol for more than 30 seconds. Inspect cups for deterioration such as scoring, scuffing, blistering, cracking, chipping (heel abrasion) and change in shape from original appearance. Inspect cylinder parts, recording pittings on piston or cylinder walls. The lip diameter of the primary cup shall be measured within 30 to 60 minutes after removal from the cylinder and the difference between the actual cylinder bore the diameter after the test, shall be determined and recorded for both primary and secondary cups. Determine and record the change in hardness within 30 to 60 minutes after removal from the cylinder.

G-4.2 The wheel cylinder cups shall be rinsed in isopropyl alcohol or ethyl alcohol and wiped dry with a clean, lint-free cloth to remove dirt and packing debris. Cups shall not remain in the alcohol for more than 30 seconds. The lip diameter measurement shall be determined to the nearest 0·02 mm, taking the average of two readings at right angles to each other. In the case of double lip cups, these measurements shall be taken after the cup has been assembled on the piston. Determine and record the initial hardness of the test cups. The internal parts which may include among other things, cups, piston springs, expanders, etc, shall be installed in a wheel cylinder of known diameter using the test fluid as a lubricant. Boots shall not be used. Install the wheel cylinder assembly on the stroking fixture. The stroking fixture assembly shall be placed in an oven with the test conditions in accordance with G-3 above. After one hour minimum operation, place a sheet of filter paper under each end of the wheel cylinder to collect and determine leakage. Inspect filter paper at least twice for discolouration at not less than 24h intervals. Filter paper is to be changed if discoloured from fluid leakage. The actuating means and the oven heating shall be shut off at the termination of the 70 h /120 h duration as applicable and stroking period with the master cylinder piston in the 'off' position to relieve retained pressure in the system. After one hour cooling period with the oven door open, and a ventilating fan 'on', disconnect the fluid line at the wheel cylinder inlet.

Remove the entire stroking test fixture containing the test wheel cylinder from the oven and allow to cool for 22 ± 2 h at room temperature. Immediately after completion of the 22 h cooling period, careful inspection shallbe made to check for fluid leaks past the cups and results recorded. The fluid shall be drained from the system, and the cups shall be removed from the wheel cylinder.

Double lip cups shall be measured before removal from the pistons. The cups shall be rinsed in isopropyl or Ethyl alcohol and dried with compressed air. Cups shall not remain in the alcohol for more than 30 seconds. Inspect cups for scoring, scuffing, blistering, cracking, (heel abrasion), and change in shape from original appearance. Inspect cylinder parts, recording any pitting on pistons and cylinder walls.

Determine and record the change in hardness.

The lip diameter of each cylinder cup shall be measured within 30 to 60 minutes after removal from the wheel cylinder and the difference between the actual cylinder bore and the lip diameter after the test shall be reported.

ANNEX H

[*Clause* 6.1 (h)]

OZONE RESISTANCE TEST

H-1 TEST SPECIMEN

H-1.1 Two cups shall be taken as test specimen.

H-2 TEST PROCEDURE

H-2.1 For conducting test, an ozone chamber as shown in Fig. 8 or 9 capable of maintaining an ozone concentration of 50 ± 5 ppm is recommended. A suitable stretching mandrel to suit the sealing end attached to cylinder such that the diameter is 115 percent of the moulded diameter of the specimen cup end, is made available to carry out the test.

Assemble the cups on the stretching mandrel and allow to rest for 22 ± 2 hours at room temperature, then subject the rubber cups installed on the mandrel to an ozone concentration of 50 ± 5 ppm by volume at 40 ± 2°C for 70 ± 2 hours.

At the end of the exposure, the cup surface shall be free from cracks.

NOTE — Fig. 8 and 9 provide typical arrangement for ozone cracking chamber. However, an acceptable ozone chamber is one that has sufficient air ozone throughout rate, internal circulation and volume. The volume of the chamber shall be at-least 0·11 to 0·14 m^3. It is also recommended that the generation source is kept outside the chamber with filtration of foreign matter from the strainer. The recommended partial pressure of ozone shall be approximately 50 MPa. The air ozone velocity can be 0·6 m/s. The normal source of ozone is the mercury vapour lamp.

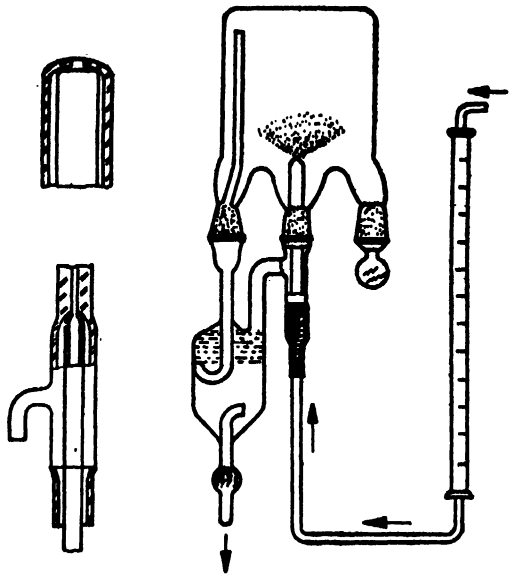


FIG. 8 OZONE ABSORBING DEVICE (SPRING JET TYPE)

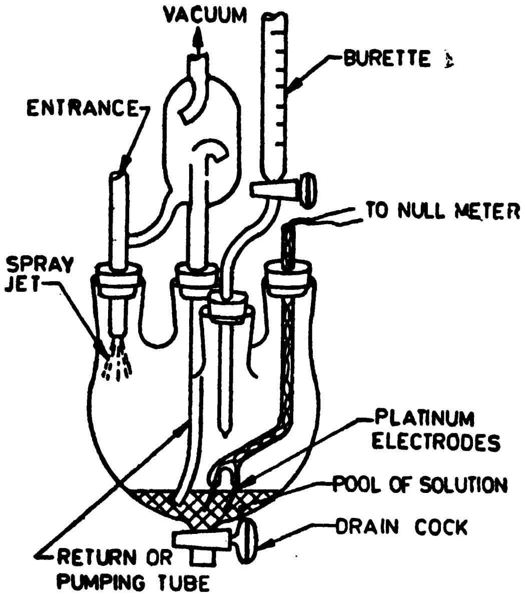


FIG. 9 MODIFIED SPRAY JET APPARATUS

Standard Mark

The use of the Standard Mark is governed by the provisions of the *Bureau of Indian Standards Act, 1986* and the Rules and Regulations made thereunder. The Standard Mark on products covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of that standard under a well defined system of inspection, testing and quality control which is devised and supervised by BIS and operated by the producer. Standard marked products are also continuously checked by BIS for conformity to that standard as a further safeguard. Details of conditions under which a licence for the use of the Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

Bureau of Indian Standards

BIS is a statutory institution established under the *Bureau of Indian Standards Act, 1986* to promote harmonious development of the activities of standardization, marking and quality certification of goods and attending to connected matters in the country.

Copyright

BIS has the copyright of all its publications. No part of these publications may be reproduced in any form without the prior permission in writing of BIS. This does not preclude the free use, in the course of implementing the standard, of necessary details, such as symbols and sizes, type or grade designations. Enquiries relating to copyright be addressed to the Director (Publication), BIS.

Revision of Indian Standards

Indian Standards are reviewed periodically and revised, when necessary and amendments, if any, are issued from time to time. Users of Indian Standards should ascertain that they are in possession of the latest amendments or edition. Comments on this Indian Standard may be sent to BIS giving the following reference :

Doc : No. TED 4 (5400)

Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

BUREAU OF INDIAN STANDARDS

Headquarters :
Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi 110002
Telephones : 331 01 31, 331 13 75
Telegrams : Manaksanstha
(Common to all Offices)

Regional Offices :	Telephones
Central : Manak Bhavan, 9 Bahadur Shah Zafar Marg, NEW Delhi-110002	331 01 31 331 13 75
Eastern : 1/14 C.I.T. Scheme VII M, V.I.P. Road, Maniktola CALCUTTA 700054	37 86 62
Northern : SCO 445-446, Sector 35-C, CHANDIGARH 160036	53 38 43
Southern : C.I.T. Campus, IV Cross Road, MADRAS 600113	412916
Western : Manakalaya, E9 MIDC, Marol, Andheri (East) BOMBAY 400093	6 32 92 95

Branches : AHMADABAD, BANGALORE, BHOPAL, BHUBANESHWAR,
COIMBATORE, FARIDABAD, GHAZIABAD, GUWAHATI,
HYDERABAD, JAIPUR, KANPUR, PATNA, THIRUVANANTHAPURAM.

Printed at Swatantra Bharat Press, Delhi, India